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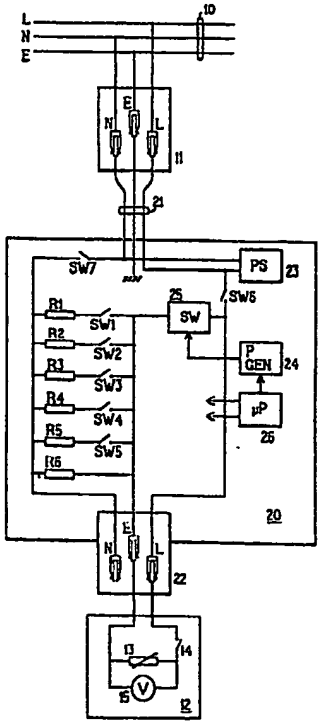
(54) Calibrator for loop impedence tester

(57) To calibrate a loop impedance tester 12 which is used to test the resistance of a mains supply between live and earth, by putting a very low resistance 13 across the mains supply for a short period and measuring 15 the resulting current, the tester 12 is connected to the mains supply 10 through a calibrator 20 which can be stepped through a plurality of known resistances R1-R6, together with selectable mechanical relays or switches SW1-SW5, and a pulse generator 24 and switch 25 pass a preliminary high current pulse through the contacts each time the contacts are closed. This conditions the contacts by changing their resistance to a much more consistent value.



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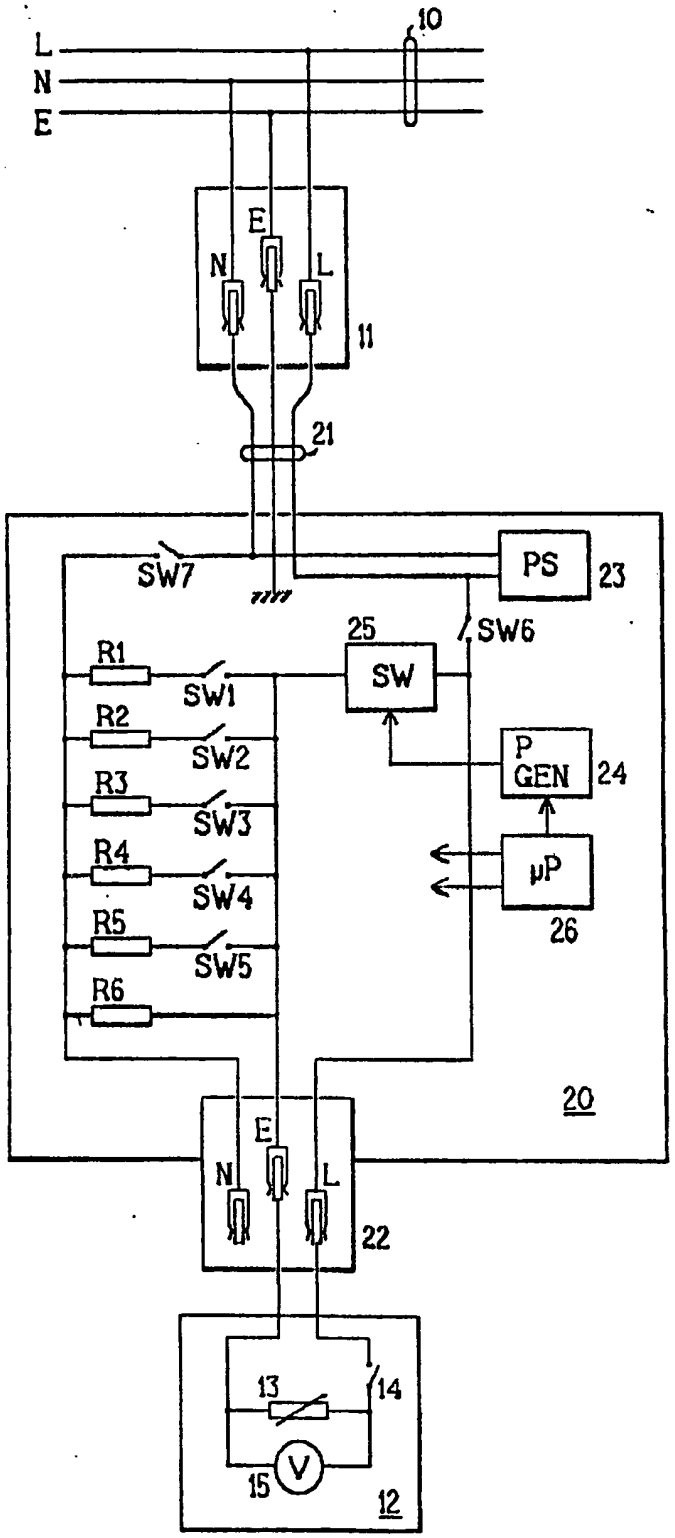
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Calibrator for Loop Impedance Tester

The present invention relates to calibrators for loop impedance testers.

A loop impedance tester is a well-established device for testing the resistance of a mains supply between live (phase) and earth. This is required for testing mains supplies, to determine whether there are unacceptable resistances in the mains supply. (In the UK, such testing is specified by the IEE Wiring Regulations, 16th edition.)

A loop impedance tester essentially operates by putting a very low resistance across the mains supply for a short period, and measuring the resulting current. The resistance in the tester is effectively connected in series with the mains resistance and the mains voltage applied to this series circuit; from the voltage drop across the resistance in the tester, the mains resistance can then be determined. The period of the test is typically a few half-cycles of the mains supply.

Such testers require calibration and checking, and this is conventionally done under actual operating conditions, ie by connection to a mains supply. However, this technique relies on the mains supply used for testing being known to have negligible loop impedance, and such a reliable mains supply may not be readily available.

An alternative calibration and checking technique has been proposed, in which the tester is connected to the mains supply through a calibrator, which can be stepped through a plurality of known resistances. The mains PE (phase to earth) resistance must be known, and this is then combined with the calibrator resistances to determine what the tester resistance readings should be. Alternatively, the (unknown) mains resistance can be determined from the readings of the tester for the different calibrator resistances, and the tester readings then checked against the sum of the mains and calibrator resistances. A further possibility is to assume that the mains resistance is negligible. (The mains resistance can usually be minimized by connecting the calibrator between live (phase) and neutral rather than earth.)

We have found that in practice, this technique has a practical drawback. It is convenient to use, in the calibrator, a set of resistors of predetermined resistances, together with mechanical relays or switches for selecting them. But the resistances of such mechanical contacts are comparable with the resistances of the smallest resistors and, worse, the contact resistances vary between closures.

We have also discovered that this problem can be alleviated or overcome, by passing a preliminary high current pulse through the contacts each time any of the contacts are closed. This is therefore the crux of the invention. We have found that such a high current pulse conditions the contacts by changing their resistance to a much more consistent value; the conditioned resistance is also, usefully, lower than most initial resistances.

A calibrator for a loop impedance tester embodying the invention will now be described, by way of example, with reference to the drawing, which is a simplified circuit diagram of the calibrator with a loop impedance tester connected to it.

Referring to the drawing, a mains supply 10 consists of the usual phase or live (L), neutral (N), and earth (E) wires (this supply being a single-phase one). Connected to this supply is a standard socket 11, having live (L), neutral (N), and earth (E) pins as shown.

To determine the loop (phase to earth) impedance of this supply, a loop impedance tester 12 would be used. This tester consists (in simplified terms) of a plug which will plug into the socket 11, a step-adjustable resistor 13 which is connected between the live and earth pins of the plug, a switch 14 which is operable to be closed for a suitable short period (typically a few half-cycles of the supply), and a meter 15 which measures the voltage across the resistor 13. The voltage so measured is some fraction of the (known) mains voltage, determined by the ratio of the resistance 13 to the total resistance (resistance 13 plus the supply loop resistance). From this, the loop resistance can be determined (and read off directly if the meter is appropriately calibrated).

The operation of the tester 13 is of course dependent on the accuracy of its various components, and these are liable to long-term drifts. If is therefore desirable to calibrate the tester at suitable intervals. This calibration is preferably done under working conditions.

As explained above, it would be possible to calibrate the tester by connecting it to a mains supply which is known to have negligible loop impedance. However, this would require a carefully chosen and unusual mains supply. It is therefore more convenient to use the present calibrator.

The calibrator 20 has a mains lead 21 with a plug which fits into the socket 11, thereby making earth, live, and neutral available to the calibrator. The calibrator also has a conventional mains socket 22, into which the tester 12 is plugged. The function of the calibrator is to present to the tester a mains voltage having an adjustable resistance of known magnitude.

The calibrator connects the mains voltage through itself, from the socket 11 to the socket 13, adding an adjustable series resistance as described below. The true mains loop resistance appears in series with the resistance added by the calibrator. In practice, it is found that the mains loop resistance between live and neutral is usually less than that between live and earth. The calibrator therefore couples the live and neutral wires of cable 21 to the live and earth pins of socket 22.

The live pin of cable 21 is connected to the live pin of socket 22 substantially directly, via only a switch SW6. The neutral pin of cable 21 is connected to the earth pin of socket 22 via a switch SW7 and a set of resistors R1 to R6, each of which (apart from R6) has a switch (SW1 to SW5) connected in series with it. The neutral pin of cable 21 is also connected to the neutral pin of socket 22 via the switch SW7, to improve the emulation of a true mains socket by socket 22.

In use, the switches SW1 to SW5 are set to give a desired resistance, switches SW6 and SW7 are closed, and the tester 12 is operated. The resistance indicated by the tester is then compared with the actual resistance set by the calibrator. The resistors R1 to R6 may conveniently have values 0.2 Ω, 0.5 Ω, 1 Ω, 10 Ω, 100 Ω, and 1 kΩ (it will be understood that these values include lead resistances). The calibrator may also include means (not shown) for determining the mains loop impedance of the supply 10 and indicating the actual impedance (mains impedance plus the impedance set in the calibrator).

The resistance of the switches SW1 to SW5 is, as discussed above, significant (at least for the smaller resistors - say R1, R2, and R3) and is not consis-

tent; that is, its value differs from one closing of a switch to the next. The calibrator therefore includes a power supply 23 energized from the cable 21, a pulse generator 24, and a switching device 25 connected between the live and earth pins of the socket 22.

The pulse generator is operated after the switches SW1 to SW5 have been set to their desired states, but before the tester 12 is operated. The pulse from it operates the switching device 25, which preferably comprises a triac. This effectively connects the resistors R1 to R6 are their associated switches SW1 to SW5 across the mains voltage (between live and neutral) for a half cycle. A high current pulse therefore flows. As described above, this high current pulse conditions the switch contacts of the closed switches, reducing their resistance to a low value which is much more consistent than the original value.

The switches SW1 to SW5 are in fact relays, as relay contacts can tolerate the high currents involved. The relays are operated by coils (not shown) energized by a microprocessor 26. Each time the relays are operated, the microprocessor 26 sends a signal, after a suitable delay to allow the relays to settle, to the pulse generator 24 to cause it to produce a pulse which is sent to the switch 25.

Although the high current pulse for conditioning the switches is only required when a contact is being closed, it may be more convenient to generate it whenever the setting of the switches is changed, regardless of whether switches are being opened, closed, or both.

Obviously the calibrator can be built into the mains tester if desired. For this, the plug and socket 22 would obviously not be required, and an additional switch (not shown) would be included between the earth lead of the mains tester portion 12 and the earth pin of the plug 11.

Claims

1 A calibrator for a loop impedance tester (which tests the resistance of a mains supply between live (phase) and earth by putting a very low resistance across the mains supply for a short period and measuring the resulting current) which is connected to the mains supply through the calibrator, the calibrator including a plurality of resistors of known values arranged between the mains and the mains tester and mechanical switches for selecting the resistors, and means for passing a preliminary high current pulse through the contacts of the switches each time any of the contacts are closed.

2 A calibrator according to claim 1 wherein the live terminal of the plug to the mains is connected to the live terminal of the socket for the loop tester and the neutral terminal of the plug to the mains is connected through the resistors and switches to the earth terminal of the socket for the loop tester.

3 A calibrator for a loop impedance tester, substantially as herein described.

4 A loop impedance tester including a calibrator according to any previous claim.

5 Any novel and inventive feature or combination of features specifically disclosed herein within the meaning of Article 4H of the International Convention (Paris Convention).

Patents Act 1977
Examiner's report to the Comptroller under Section 17 (The Search Report)

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Relevant Technical fields

(i) UK Cl (Edition L) G1U UR2718, UR3500

(ii) Int Cl (Edition 5) G01R 27/18, 35/00

Search Examiner

K F J NEAL

Databases (see over)

(i) UK Patent Office

(ii) ONLINE DATABASES: WPI

Date of Search

8 OCTOBER 1993

Documents considered relevant following a search in respect of claims 1-4

Category (see over)	Identity of document and relevant passages	Relevant to claim(s)
	NONE	

Category	Identity of document and relevant passages	Relevant to claim(s)

Categories of documents

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